Biston herefordi (♀ *betularia* x ♂ *strataria*): The H. B. D. Kettlewell 1974 Hybrids, A Report

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In February 1979, I happened to see an advertisement in the Insektenbörse for German pupae of *Biston strataria.* Having at that time large stocks of *Biston betularia* pupae of the three forms, *carbonaria, insularia* and typical I thought it would be of interest to try and obtain the cross between *betularia* and *strataria* which I knew had been obtained before and named *herefordi* (Tutt). To my surprise I could find no reference to the hybrid in Bernard Kettlewell's book "Evolution of Melanism", so I wrote to him as I felt sure he had bred the insect. He replied (21st March 1979) "Thank you for nudging my elbow re the hybrid *betularia* x *strataria.* I am amazed to find that I have never published the results. I managed to obtain with very great difficulty two pairings, ♀ *betularia typica* x ♂ *strataria.* I obtained a small number of imagines from both these pairings and in one brood there was complete segregation of typical and melanic". He continued "I took considerable time and trouble to develop the technique of producing *herefordi,* the main thing being that the Peppered Moth pupae must be put into warmth at an early date so that they hatch in late March when *strataria* is available. The technique of producing the hybrid I am sure you know well. The ♀ *betularia* and ♂ *strataria* are put together in a cage which is flooded with scent of ♀ *strataria,* which is obtained by having some virgin ♀♀ *strataria* in a muslin bag inside the cage or just adjacent to it".

In the meantime I (C.A.C.) went ahead with my own *herefordi* project and first looked up the references. Tutt, (1906) states "In 1890, Chapman forced pupae of *Amphidasys betularia* in order to pair the imagines with those of *A. prodromaria* (= *strataria*) and succeeded in obtaining a pairing, a ♂ *A. strataria* with a large black ♀ *A. betularia.* Many fertile eggs were laid, the larvae hatched and fed up well, some half-dozen missing a moult, not feeding died (sic) without being up to full size, and assuming the pupal stage earlier than the others. All the imagines from these emerged in autumn or winter and died without being observed at the time. The rest of the larvae only produced about a dozen pupae, which refused to be forced, and died with the exception of two, which lived on until June, apparently meaning to go over until another season (Ent. Rec., ii, p. 83)". Tutt (1906) continues, when contrasting various interspecific hybrids, "the larvae of *Amiphidasys* hybr. *herefordi* (Ent. Rec., ii, p. 83) showed great variation in the rate of feeding up, and in the length of the pupal stage. Some half-dozen of these larvae missed a moult, pupated early, and produced imagines the same autumn, whilst the rest developed into pupae which went over the winter, one attempting to go over a second winter"**

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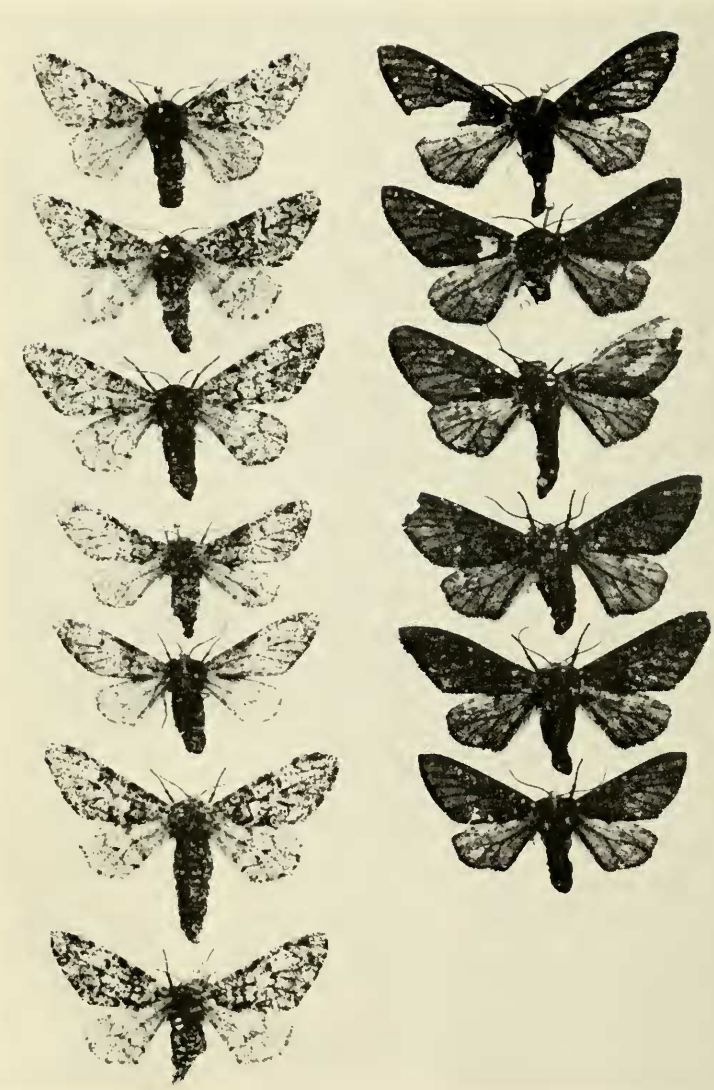
** The full text of Chapman's note is given as an appendix.



Biston herefordi Tutt
Brood StB/12/74 showing segregation of the two forms.
In Brood StB/14/74 all the insects were of the pale form (not shown).

Scorer, A. G., (1913), also mentions the hybrid and again as occurring between ♀ *betularia* and ♂ *strataria* and not the reciprocal.

Siggs, L. W., (1976) reported a successful pairing between a ♀ *insularia* and a ♂ *strataria*. He distributed the eggs among various colleagues, including Dr. Kettlewell. The total emergences amounted to only four moths (Dr. J. A. Bishop, University of Liverpool, *pers. comm.*) and these appeared to resemble *insularia* though in no case did the wings expand properly. This was probably because, unexpectedly, the insects came out in the summer about two weeks after pupation and the breeding arrangements were unsatisfactory. In none of these references is there any mention of trick pairings, so presumably this is not obligatory.

Bernard Kettlewell had asked me to send him any references which I found and this I did on 12th April 1979, by which time he was in failing health. After his death on 11th May 1979, Mrs. Kettlewell sent me the *herefordi* moths and asked me to write up the work, and Mrs. R. M. Wickett, Bernard's secretary, sent me his notes.

The details of his two broods are set out below.

The Kettlewell (1974) broods of B. herefordi

Brood St.B/12/74 ♀ f. *carbonaria betularia* x ♂ *strataria* ex Steeple Barton (see plate). Mating presumably carried out in April 1974, eggs hatched 8.5.74.

Emergences	typicals	melanics
27.8.74	3 ♀♀	5 ♀♀
	1 ♀ cripple	
28.8.74	1 ♀ cripple	
4.9.74		1 ♀
9.9.74	1 ♀ cripple	1 ♀
	2 ♀♀	
12.9.74	2 ♀♀	
18.9.74	1 ♀ cripple	

Brood St.B/14/74 ♀ typical *betularia* x ♂ *strataria* ex Steeple Barton. Mating presumably carried out in April 1974, eggs hatched 10.5.74.

Emergences	typicals
9.9.74	1 ♀ black body
10.9.74	1 ♀ normal body
12.9.74	3 ♀♀, 1 with black body
16.9.74	1 ♀ cripple, dead

There is no record of any attempts at back crosses or F_2 pairings.

Brood St.B/12/74 is shown in the plate. It will be noticed that the *"carbonaria"* are very similar to pure *betularia* f. *carbonaria* and would certainly be scored as such (though small) if caught in an M.V. trap. The light coloured insects, however, are intermediate between *strataria* and *betularia*. In brood St.B/14/74 where there was no melanic *betularia* parent, all the insects are intermediate between *betularia* and *strataria*.